

REMARKS

1. In response to the final Office Action mailed December 5, 2002, Applicant respectfully requests reconsideration. Claims 1-29 and 44-65 were last presented for examination in this application. In the final Office Action, claims 1-29 and 44-65 were rejected. By the foregoing amendments, independent claims 1, 25 and 44, and dependent claims 53-54, 57, 59, 60-62 and 64 have been amended. No claims have been added or canceled. Thus, claims 1-29 and 44-65 will be pending in this application after entry of this paper. These amendments are believed not to introduce new matter and their entry is respectfully requested. Based on the above Amendments and below Remarks, Applicant believes the application is in a condition for allowance, and therefore kindly requests reconsideration of the claims and withdraw of all objections and rejections, leading to allowance forthwith.

Objections to the Drawing, Abstract and Specification

2. The Examiner has objected to the drawings as failing to comply with 37 CFR 1.84 *et seq.* Formal drawings were previously submitted but apparently not made of record at the time the Examiner prepared the Office Action. It appears that such formal drawings include minor changes not approved by the Examiner. To obtain the Examiner's approval of the prior changes, as well as to change the drawings to accommodate the noted objections, informal drawings with red-lines showing all changes are attached hereto in Attachment 4. It is believed that which these corrections, the objections are overcome, hence, Applicant kindly requests withdrawal of these objections. The Examiner has also objected to the abstract and specification. The above amendments overcome these objections, too. Hence, Applicant also kindly requests withdrawal of these objections.

Claim Rejections

3. The Examiner has rejected claim 57 under 35 USC 112 as being indefinite by failing to particularly point out and distinctly claim the subject matter which Applicant regard as the invention. Specifically, claim 57 recites, "said data structure has a data format suitable for the implementing application," rendering it indefinite as to the "implementing application" claimed.

4. Claim 57 has been amended to recite "... said data structure has a data format suitable for an implementing application." It is now definite under §112 and supported by the specification. Applicant kindly requests reconsideration and withdrawal of this rejection.

5. The Examiner also rejects claims 1-3, 24, 25, 44, 49 and 50 under 35 USC 103(a) as being anticipated by U.S. Patent No. 5,532,944 to Battista (hereinafter "Battista") in view of U.S. Patent No. 6,301,547 to Felps (hereinafter "Felps") and further in view of U.S. Patent No. 4,864,512 to Coulson et al. (hereinafter "Coulson"). Although Applicant believes that these claims are allowable as written, nonetheless, to explicitly clarify what was implicit, the above amendments to independent claims 1, 25 and 44 are made and the Examiner's rejections are respectfully traversed. Applicant kindly requests reconsideration and allowance of all outstanding claims.

6. The Examiner asserts that Battista substantially teaches Applicant's claimed invention as recited in independent claims 1, 25 and 44. The Examiner concedes, however, that Battista fails to teach three limitations: (1) implementing the pulse management system in a digital oscilloscope; (2) performing measurements on previously acquired data stored in an acquisition memory; and (3) performing statistical analyses on the stored pulse measurement results/characteristics. To correct for these deficiencies, the Examiner asserts that Felps discloses a method for automatically acquiring and storing waveform measurements using a measuring instrument such as an oscilloscope, and further discloses storing acquisition data in memory for measurements allowing the operator to select which previously acquired signals are to be processed. The Examiner also asserts that any remaining deficiencies are disclosed by Coulson which teaches a measurement apparatus with plural displays of measured parameters including performing statistical analyses on measurement results, the results of which are stored together in an accessible data structure in a corresponding memory.

7. From these observations, the Examiner takes the position that it would have been obvious to one of ordinary skill in the art at the time of invention to incorporate the teachings of Felps and Coulson into the Battista system, and that such modification would result in Applicant's claimed invention. The Examiner sets out a number of supporting motivations for such a modification. These include storing of the acquired data in memory and then allowing the operator to select which acquired signals to process and

store in an accessible data structure as taught by Felps and Coulson, and automatically acquiring and storing waveform measurements as taught by Felps would allow the operator to perform other tasks during the waveform measurement process. Further, because that capability allows an operator to store multiple waveforms and then return at a later time to process selected ones and allows for both measurement values and statistical results to be displayed simultaneously, a troubleshooting efforts would be more efficient. The Examiner also asserts that one skilled in the art would modify Battista with an oscilloscope as taught in Felps because digital oscilloscopes are conventionally used to perform measurements of various types of signals including pulses, and are functionally equivalent to multi-channel analyzers.

8. Applicant respectfully traverses these rejections for at least the following reasons: (1) the proposed modification of Battista is improper because there is no teaching or suggestion therein or of other art of record that it should be modified, much less that it be modified in the manner proposed; and (2) even if Battista were combined with Felps and Coulson as proposed by the Examiner, the resulting device would not contain all the elements of the claimed invention.

The Proposed Combination of Battista in view of Felps and Coulson Is Improper

9. The Examiner has not provided proper support for the assertion that one of ordinary skill, without having the benefit of Applicant's novel teachings, would have been motivated to make the combination of elements required to create the signal measurement system of the claimed invention. Neither Battista, Felps nor Coulson – nor other art of record – contains any teaching or suggestion whatsoever to combine the teachings of Felps and Coulson with Battista in any way, much less in the manner proposed by the Examiner. As noted, the Examiner contends that the three noted reasons support the proposed combination and references. Each of the Examiner's reasons is refuted below.

10. The Examiner asserts that one motivating factor to modify Battista with the teachings of Felps and Coulson is to free the operator to perform other tasks while awaiting for measurement date. Battista, however, is particularly directed to *automated* real-time detection and waveform height analysis of pulses generated by a scintillation-type radiation detector, Col. 1, lines 18-22. No operator intervention is required – or indeed

permitted – while the system of Battista is operational. Hence, there would be no motivation to add automation features of either Felps or Coulson to an already automated system which the operator is *required* to not operate during measurement.

11. Another motivating factor asserted by the Examiner is to modify Battista with the consolidated display of a measurement and a statistical confidence level of that measurement as taught by Coulson. Battista, however, already provides for simultaneously displaying multiple statistics including pulse height, region-of-interest count rate and gross pulse count. Further, there is no need in Battista to display a statistical confidence of a measured value since it already has automated features which correct for base-shift and interleaving of pulses, each maximizing the confidence level of the measurements. As above, there would be no motivation to augment Battista with what is already there.

12. A further motivating factor asserted by the Examiner is to modify Battista to store multiple waveforms allowing the operator to return at a later time to process selected ones. However, Battista discloses the continual measurement of a waveform, and produces a running total of gross pulse count and region-of-interest rate processing. Adding an ability to store a waveform for future processing would only serve to delay an operator from acquiring updated statistics and would not serve to save time but rather, would increase the time required to obtain waveform statistics.

13. Accordingly, Applicant respectfully asserts that no legitimate rationale for modifying Battista is suggested in the Office Action. For this reason alone, Applicant respectfully requests that the rejections under Section 103 be withdrawn and the claims allowed.

Even if Battista Were to be Combined with Felps and Coulson, The Resulting Device Would Not Contain All of the Features of Applicant's Claimed Invention

14. Even if Battista were combined with Felps and Coulson as suggested by the Examiner, the resulting device would still not result – nor have the advantages of – the claimed invention without substantial modifications being made to the resultant system.

15. Although Applicant believes that the independent claims 1, 25 and 44 are allowable as written, to make explicit what was implicit, each of these claims now recite, *inter alia*, a *searchable database* of pulse characteristics. For example, claim 1 recites:

1. A signal measurement system comprising:
 - an acquisition memory; and
 - a pulse management system configured to automatically perform a series of pulse measurements on a previously-acquired time-varying analog signal comprising a plurality of pulses, samples of which are stored in the acquisition memory, wherein the pulse management system generates for storage in a *searchable data structure* pulse characteristics of each of the plurality of pulses, wherein for each of the plurality of pulses, said pulse characteristics comprise results of the one or more pulse measurements.

Independent claims 25 and 44 echo this feature of a searchable database.

17. This combination of recitations, and specifically a recitation of a searchable database, is nowhere taught or suggested by Battista, Felps, Coulson, or other art of record. While Battista does disclose a First-In-First-Out (FIFO) memory, it is well known that such memory is not suited for any searching of data therein. Felps discloses only an acquisition memory and provides for storing only one waveform – there is no teaching or suggestion of storing characteristics of that waveform, much less of searching a database for those characteristics based on search criteria. Coulson discloses a memory capable of storing one or more measured values and a resultant of a mathematical formula related to each of those values. But again, there is no teaching or suggestion of searching any database according to operator supplied search criteria, but rather, only displaying a measurement value and a statistical function of that value.

18. For at least these reasons, Applicant respectfully asserts that Battista, Felps, Coulson and other art of record, taken alone or in any combination, neither teach nor suggest the features of the claimed invention as recited. In fact, there is no suggestion at all in the art of record or providing a system in which the user can search a data structure containing pulse characteristics using operator supplied criteria

19. Accordingly, Applicant kindly requests consideration of the independent claims and allowance forthwith. Further, because each of the dependent claims contain all the limitations of its respective independent claims, each is also allowable over the cited art for at least all the same reasons.

20. The following Attachments are submitted with this paper, the page numbers of which are consecutively numbered herewith:

ATTACHMENT 1: Marked up Version of Claims Showing All Changes Made

ATTACHMENT 2: Marked up Version of Specification Of Record Showing All
Changes Made

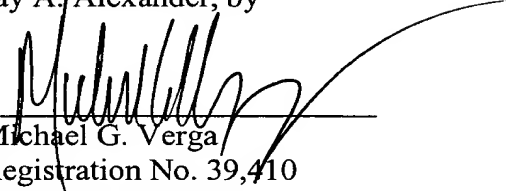
ATTACHMENT 3: Marked up Version of the Abstract Of The Disclosure
Showing All Changes Made

ATTACHMENT 4: Red-lined Version of the Drawings.

CONCLUSION

20. In view of the foregoing Amendments and Remarks, this application should now be in condition for allowance. A notice to this effect is respectfully requested. If the Examiner believes, after entering this paper into the record, that the application is not in condition for allowance, the Examiner is requested to call the Applicant's representative at the number provided below.

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Docket No. 10961066-1
Dated: February 5, 2003

ATTACHMENT 1: Marked up Version of Claims Showing All Changes Made

1. (Twice Amended) A signal measurement system comprising:

an acquisition memory; and

a pulse management system configured to automatically perform a series of pulse measurements on a previously-acquired time-varying analog signal comprising a plurality of pulses, samples of which are stored in the acquisition memory, wherein the pulse management system generates for storage in [an accessible] a searchable data structure pulse characteristics of each of the plurality of pulses, wherein for each of the plurality of pulses, said pulse characteristics comprise results of the one or more pulse measurements.

25. (Twice Amended) A signal measurement system comprising:

an acquisition memory; and

a pulse management means for automatically performing a series of pulse measurements on a previously-acquired time-varying analog signal comprising a plurality of pulses, samples of which are stored in the acquisition memory, and for generating for storage in [an accessible] a searchable data structure pulse characteristics of each of the plurality of pulses, wherein for each of the plurality of pulses, said pulse characteristics comprise results of the one or more pulse measurements.

44. (Twice Amended) A method for generating a searchable pulse data structure for storage in a memory apparatus operationally coupled to a signal measurement system, said data structure comprising a plurality of signal pulse characteristics of pulses of [an] a previously-acquired time-varying analog signal samples of which are stored in an acquisition memory of the signal measurement system, the method comprising the steps of:

1) automatically performing a series of pulse measurements on a previously-acquired time-varying analog signal comprising a plurality of pulses, samples of which are stored in the acquisition memory; and

2) generating for storage in [an accessible] a searchable data structure pulse characteristics of each of the plurality of pulses, wherein for each of the plurality of pulses, said pulse characteristics comprise results of the one or more pulse measurements.

53. (Amended) The signal measurement system of claim 52, wherein said signal pulse characteristics further comprise:

a time of occurrence data unit associated with each pulse identifier data unit in said [data structure] database, said time of occurrence data unit indicating a time said associated pulse occurred relative to a time at which a trigger event causing said storage of said acquired signal occurred.

54. (Amended) The signal measurement system of claim 53, wherein said [data structure] database further comprises:

global measurement statistics data units for one or more of said plurality of pulse measurements, wherein said global statistics are associated with said acquired signal in said data structure.

57. (Amended) The signal measurement system of claim 52, wherein said [data structure] database has a data format suitable for an [the] implementing application.

59. (Amended) The signal measurement system of claim 54, wherein each of said plurality of pulse measurement results data unit associated with each of said plurality of pulse identifier data units in said [data structure] database comprise one or more of the group consisting of:

- rise time measurement results;
- fall time measurement results;
- pulse width measurement results;
- preshoot measurement results;
- pulse area measurement results;
- minimum voltage measurement results;
- maximum voltage measurement results;
- average voltage measurement results;
- volts AC RMS measurement results;
- volts DC RMS measurement results;
- amplitude voltage measurement results;
- base voltage measurement results;
- top voltage measurement results;
- upper voltage measurement results;
- middle voltage measurement results;
- lower voltage measurement results;
- plus width measurement results;

minus width measurement results;
positive duty cycle measurement results;
negative duty cycle measurement results;
period measurement results;
phase measurement results;
frequency measurement results;
delta time measurement results;
peak-to-peak voltage measurement results; and
overshoot measurement results.

60. (Amdended) The signal measurement system of claim 52, wherein said plurality of pulse identifier data units and said associated pulse characteristic data units are arranged in said [data structure] database in a same sequence as said corresponding signal pulses occur.

61. (Amended) The signal measurement system of claim 52, wherein said pulse characteristic data units and said pulse identifier data units are stored in said pulse [data structure] database automatically and with no operator involvement.

62. (Amended) The signal measurement system of claim 52, wherein said [data structure] database is populated automatically and in accordance with measurement parameters.

64. (Amended) The signal measurement system of claim 52, wherein said [data structure] database is generated and populated by said pulse characteristics in response to an acquisition memory storing said acquired signal.

**ATTACHMENT 2: Marked up Version of Specification Of Record
Showing All Changes Made****page 3, Ins. 1-19**

Whether or not [mot] anomalous pulses are present in the acquired signal, the operator may wish to determine the statistics of certain measurements across a large number of pulses in the acquisition for the purpose of margins analysis. For example, the duty cycle of a clock waveform may need to be analyzed to insure that the minimum and maximum bounds are not exceeded. Some conventional systems include facilities for determining measurement statistics, however, in such implementations, the statistics are accumulated from measurements performed over multiple acquisitions and/or the results are computed such that a given measurement value is not readily traceable to the pulse it is associated with. Accumulating statistics over multiple acquisitions is disadvantageous because the acquisitions may relate to different operating conditions in the circuit or system being analyzed. Additionally, depending on how many pulses are measured from each acquisition, the time spacing between measured pulses may vary significantly, making statistical understanding less straightforward. When statistics are computed without traceability to individual pulses, the operator is unable to view the particular pulse associated with the given measurement result. Without a view of the pulse, the operator is at a loss to determine when caused the measurement result. In sum, in currently available signal measurement systems, it is difficult for an operator to characterize or troubleshoot a system or circuit through analysis of the large number of pulses that may be captured in a single acquisition.

page 21, ln. 24-page 22, ln. 4

Specifically, pulse analyzer 204 searches pulse data array 206 [204] for pulses that satisfy an operator-generated search criteria. Similarly, pulse analyzer 204 sorts the selected subset of pulses based on an operator-generated sort criteria. Pulse analyzer 204 provides the operator with a graphical user interface environment in which the operator may specify the search and sort criteria and in which pulse analyzer 204 may display the selected pulses with their associated pulse measurement results. Pulse analyzer 204 can also display the results of the search and sort operations, and other information related to pulse data array 206 that is related to the operator's investigation into the acquired signal.

In accordance with one embodiment of the invention, pulse data array query 214 includes queries for measurement statistics 324, and reply 216 includes the requested statistics.

page 22, lns. 17-22

Figure 11 is a high-level flow chart of the processes performed by pulse manager 118 in accordance with one embodiment of the present invention. At block 1102, pulse manager 118 [18] generates a pulse data array 206 having stored therein pulse characteristics of a previously acquired signal. At block 1104, the contents of the pulse data array are analyzed in response to operator specifications. The operations performed in blocks 1102 and 1104 are described in detail below.

page 26, lns. 4-12

Measurement source 328 uniquely identifies the acquisition signal data in the acquisition memory that is to be processed by pulse database generator 202. [302.] In embodiments such as those noted above, to uniquely identify acquisition data 208, measurement source 328 identifies the specific channel and acquisition event resulting in the capture of the desired acquisition data 208. In alternative embodiments, additional or less information is provided to histogrammer 302 depending on the function and structure of the acquisition memory. For example, in one application, at any given time, the acquisition memory stores acquisition data 208 associated with a single channel. In such circumstances, measurement source 328 need not be provided.

page 33, lns. 1-11

In the exemplary embodiment illustrated in Figure 3, pulse database generator 202 also generates measurement statistics 324. Measurement statistics 324 include global statistical values that provide insight into the acquired data 208 as a whole rather than an individual pulse. Such information serves many purposes including, for example, providing norm or average reference values when analyzing individual signal pulses. Measurement statistics include for example, the maximum, minimum, mean, mode, median and standard deviation of each signal pulse measurement. Preferably, pulse measurement engine 310 calculates measurement statistics 324 [314] as pulse

characteristics 212 is generated. As one of ordinary skill in the art would find apparent, such statistical analyses can be performed during or after the pulse measurements are performed on all pulses of the acquired signal.

page 33, lns. 20-25

Referring now to Figure 8, dialog box 800 provides a series of checkboxes 802 each associated with one or more a signal pulse measurement identifiers 804A-804G. In the embodiment shown, certain check boxes are mapped to a single signal measurement, such as rise time 804A and fall time 804B. Other checkboxes are mapped to more than one signal measurement. For example, measurement selection 802F is mapped to all signal measurements, as indicated by the identifier 804F of "All."

page 34, ln. 24-page 35, ln. 2

It is noted that in this illustrative embodiment, acquisition identifier 402 for each acquisition event is a simple integer in Figure 4 for ease of illustration. It should be appreciated, however, that values other than integers can be used to represent the acquisition in pulse data array 206. For example, a different type of data unit having the structure, size, and other attributes dictated by the implementation can be used. For example, if pulse database generator 202 and pulse analyzer 204 were implemented in the C++ programming language, then pulse data array 206 would be [a] an array of structures and acquisition number 402 might be the index into the array.

page 40, lns. 18-29

Pulse analyzer 204 is a device that implements functionality to provide an operator with the ability to search, sort, filter, select, view and otherwise manipulate pulse characteristics 212 stored in pulse data array 206. The operator can manipulate pulse characteristics 212 as necessary to select for display on user interface 116 acquired data 208 of the desired pulse along with its measurement results to gain insights into the behavior of the system or circuit being evaluated. A functional block diagram of one embodiment of pulse analyzer 204 is illustrated in Figure 5. This embodiment of pulse analyzer 204 will now be described in detail below. In the following description, pulse data array 206 is a data structure that is accessible to and usable by pulse analyzer 204.

However, it should become apparent from the following disclosure that pulse analyzer 204 [206] can be configured to operate with any data structure containing pulse characterization data 212.

page 43, ln. 18-page 44, ln. 3

Should a specified search not provide the results desired, the operator can return to dialog box 900 to modify the search criteria specifications. In addition, should the specified search be too broad and capture more pulses than desired, the operator can further refine the search through the selection of the “Refine Search” button 930 located in dialog box 900. Selection of button 930 causes the display of a “next search level” dialog box (not shown) having similar data entry fields as those shown in Figure 9. In such embodiments, searcher 502 [902] stores the specifications entered into dialog box 900 as a “level 1 search” and those entered into the next dialog box as a “level 2 search”. Searcher 502 combines the two levels of search criteria when performing a search of pulse data array 206. However, the search criteria for each level are maintained separately, enabling the operator to refine a search (with a level 2 search criteria), examine the results (of the combined level 1 and level 2 search) and return to the original, broader search (level 1 search) to refine the search again (with a new level 2 search criteria), examine the results (of the combined level 1 and new level 2 search), and so on to effect a desired result. It should be understood that any number of search levels may be managed by searcher 502.

page 44, lns. 4-12

When the operator selects the “Apply” button, graphical user interface 116 converts the data in the data entry fields of dialog box 900 into a syntax string and provides the resulting string to searcher 502 as search criteria 520. Searcher 502 then searches pulse data array 206 using the specified search criteria 520. In an alternative embodiment, upon selection of the “String Entry” button 934 [932] a single data field is displayed in which the operator can enter the search criteria in the form of a string. In such embodiments, searcher 502 preferably includes a syntax checker that verifies the command string entered and, perhaps, provides some form of assistance to educate the operator on the details of the implemented syntax.

page 46, Ins. 17-26

Of the 1075 pulses in pulse data array 206, the results of the exemplary search yielded 7 pulses; that is, of the 1075 acquired pulses, 7 pulses satisfied the specified search criteria 520. The exemplary subset index array 602 includes a subset index 608 ranging from 1 to 7, sequentially numbered with the associated pulses numbers 404 ordered from the smallest pulse number to the largest; that is, subset array 602 is simply a time-ordered list. Thus, pulse numbers 5 [6], 27, 180, 324, 641, 850 and 972 are stored in subset array 602 with subset indices of 1-7, respectively. Called out in sort index array 602 are three particular pulse numbers 7A-7C which are described below with reference to Figures 7A-7C. Also, the relationship between search index array 602 and the other arrays illustrated in Figure 6 is described below.

page 47, Ins. 2-9

As noted, pulse analyzer 204 provides the operator with the capability to sort the selected subset of acquired pulses identified in subset index array 510. Sorter 504 sorts this subset of pulses in accordance with sort criteria 524, and generates a sort index array 512 [412]. Sort index array 512 [412] is a sorted list of indices into subset index array 410, ordered in accordance with sort criteria 524. In certain embodiments, sorter 504 also generates a cross reference array 514 [414] that includes a list of sort array indices indexed by subset array indices, providing backward mapping from sort index array 512 [412] to subset index array 510 [410]. This is described in greater detail below.

page 47, Ins. 14-21

In Figure 9B a "Pulse Sort Criteria" dialog box 950 is illustrated. In this embodiment, each sort criterion 952 can be specified by the operator by entering information in data entry fields, or by selecting information from pull-down menus. The structure and operation of dialog box 950 is not described further herein due to its similarities with Pulse Selection Criteria dialog box 900 illustrated in Figure 9A and described above. It should be understood that each sort criterion 952 can be a single measurement as shown in Figure 9B, or can be an arithmetic combination of more than one measurement having common units; for example, rise time and fall time. Further, it

should be noted that multiple sort criterion 952 can have a hierarchical precedence 954, e.g., primary, secondary and tertiary precedence.

page 47, lns. 22-28

It should be noted that the breadth of options available for sort criteria 524 is significant, and stems from sorter 504 having access to pulse data array 206. Thus, sort criteria 524 is independent of search criteria 520, searcher 502 [506] and subset index array 510. In other words, access to pulse data array 206 provides sorter 504 [524] with the capability of considering any and all pulse characteristics stored in pulse data array 206. As a result, sort criteria 524 can include the same or different criteria than search criteria 520 [522].

page 47, ln. 29 – page 48, ln. 7

In operation, sorter 504 accesses subset index array 510 and retrieves sequentially each pulse number 404 stored therein. Sorter 504 then accesses pulse data array 206 with the retrieved pulse number 404. This is illustrated in Figure 5 as pulse information request 534. Sorter 504 retrieves the relevant pulse characteristics for the queried pulse number 404, as indicated by pulse information 536. Sorter 504 then applies sort criteria 524 [534], assigning a subset index to the subset index 608 [612] associated with the pulse number such that the pulse is in the appropriate relative order in sort index array 512. This process is repeated for all pulses identified in subset index array 510, with the order of the pulses changing as appropriate.

**ATTACHMENT 3: Marked up Version of the Abstract Of The Disclosure
Showing All Changes Made**

A pulse management system for use by an operator that automatically performs measurements on a subset of pulses of an acquired signal stored in [an acquisition] a memory, and generates [an accessible] a data structure that stores characteristics of the [chosen] subset of [acquired] signal pulses, including pulse measurement results. The system searches the [data] structure for pulses of the [acquired] signal that satisfy operator-provided [search] criteria. In addition, the operator can sort [the] selected pulses in [any desired manner] by specifying [a desired] sort criteria. The system displays selected pulses along and [with the] associated [measurement] results, and enables the operator to advance through the selected pulses in any manner [desired] to display different pulses together or separately along with the associated [pulse] measurement results. A method for analyzing pulses of [an acquired] a signal is also disclosed. The method includes [the step of] generating a pulse data array having a [stored therein] pulse characteristics of a previously acquired signal, followed by [the step of] analyzing the contents of the pulse data array in response to operator specifications.

ATTACHMENT 4: Red-lined Version of the Drawings

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